

In this issue

Virtual Water Flows

Economics and ecology

Many areas in Maharashtra are drought prone. But thankfully, a large portion has impervious rocks that hold groundwater aquifers. And the climatic conditions are appropriate for sugarcane, grapes and other crops that demand high amounts of water. So it makes economic sense for individual farmers to use groundwater for the irrigation of such crops.

In a General Article in this issue, Gurudas Nulkar of the Ecological Society, Pune points out that this is ecologically not sustainable. The produce from sugarcane and other water-demanding crops go through further processing, which calls for more use of water, and then, ultimately, the final products (sugar, wine, etc.) go out of the state, even out of the country. He calculates the virtual water flowing out of Maharashtra with these exports to be more than 70 million cubic metres!

Using up a locally scarce resource like water to provide for the demands of water-rich areas makes it economically unsustainable too. It would make more sense to produce and export goods from abundant and cheap resources and import goods that need intensive use of scarce resources. The microeconomic perspective of the farmers is thus in conflict with the macro-economic perspective of the state and the nation.

Policies and programmes to intervene into agricultural practices without impacting the livelihood of farmers and without ruffling political feathers are called for. Read on from **page 1349**.

Potential of Particle Accelerators

Societal, industrial, environmental

In the last five decades, quite a few particle accelerators of various kinds have been constructed in India, primarily for research purposes. Besides research, particle accelerators are useful for the diagnosis of diseases, treatment, food preservation, product sterilisation, precise ion implantation in digital electronics and equipment...

Though there is now adequate experience and expertise in India to

design and build particle accelerators for various applications, the electron accelerators operating in different hospitals and institutions for cancer treatment are all imported. The ion implanters in the manufacture of integrated circuits are also imported. There is no electron accelerator-based waste treatment plant in the country although considerable experience in related technologies using radioactive sources has been successfully generated by setting up plants at Vadodara and Ahmedabad.

In a General Article on **page 1343** in this issue, R. K. Bhandari, Inter University Accelerator Centre, New Delhi spells out the various uses of particle accelerators and the strategy to leverage on the expertise available to save on foreign exchange for importing and maintaining costly equipment.

Dates, Sesame, Chia Seeds

Evaluation as nutribars

In Mayan, Chia means strength. The civilisation flourished, consuming high amounts of polyunsaturated fatty acids, protein, fibre, minerals and antioxidants found in chia seeds. Chia cultivation on commercial scale started in India only a few years ago, and the potential for international trade has endeared the practice among many farmers. As chia seed production increases, there is a need to develop tasty, nutritious food products from chia – products with long shelf life that smooth out the seasonal swings of chia seed supply.

Researchers from the Lovely Professional University, Phagwara have now come up with an evaluation of nutribars made from various concentrations of chia with dates and sesame seeds. See the Research Article on **page 1394** in this issue for intellectual nourishment needed for assuring nutritional security.

Butterflies, Moths and Smartphones

Most of us don't distinguish between butterflies and moths. And there are hundreds of butterflies and thousands of moths. Ev333en specialists find it difficult to identify and distinguish the

species that we see around us. What if we could use our smartphones to identify the species?

The work done by K. N. Ganeshiah and team at the School of Ecology and Conservation, University of Agricultural Sciences, Bengaluru makes that possible. They started with more than 212,000 digital images of butterflies and moths from different sources. After removing duplicates, they had about 170,000 images of Indian butterflies and moths.

They selected Convolutional Neural Networks (CNN) to deal with the data. CNN has a network structure similar to that of the animal visual cortex. With adequate number of layers, neural networks can be made deep enough to be trained to respond to only a small part of the visual field and identify objects regardless of their positions in the image. The researchers purposely introduced difficulties by digitally manipulating the images to account for the variety of butterfly and moth positions, framing and lighting as might be expected in photographs from the field.

For an artificial intelligence method like CNN, a sample of even two lakh images is considered small. So the researchers split two thirds of the data set into five groups, making sure that all sets had adequate species representations and trained five different models with subsets of the split data. And they transferred the learning between the models trained by different groups to make a final automatic recognition system.

Out of the 1300 species, about 40 species are recalcitrant to recognition by the system. But Indian researchers and enthusiasts can now use the website they have created to quickly identify the species and get suggestions about the species.

The Research Communication on **page 1456** in this issue provides strategies for resolving taxonomic and species identification problems in other animals and plants.

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